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ABSTRACT

Results of the American Institute of Physics' 1982-1983 survey of physics and astronomy bachelor's degree recipients are examined. The information was obtained from individual degree recipients and focuses on their postbaccalaureate plans. Highlights of the findings are as follows: a five-percent increase over 1981-1982 occurred in the total number of physics bachelor's degrees, which was the largest number of graduates in 10 years; the number of astronomy bachelors comprised the smallest total since the mid-1970s; a gradual increase in the ages at which physics students completed their bachelor's degrees was demonstated; a further increase in the proportion of physics bachelors who did not take physics in high school occurred; and a doubling of the proportion of physics bachelors who entered the military since 1973 was found. Data are included on the following: trends in postbaccalaureate plans of physics bachelors, 1973-1983; characteristics of new physics bachelors and of new astronomy bachelors; postbaccalaureate plans of U.S. and foreign minorities among the 1983 physics bachelors; selected characteristics of minority physics bachelors; changes in employment for new physics bachelors, 1973-1983; and postbaccalaureate plans of graduating classes of astronomy bachelors, 1975-1983. (SW)

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1982-83 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECEIPIENTS

by Susanne D. Ellie

AIP Pub. No. R-211.15 March 1984

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1982–83 Survey of Physics and Astronomy Bachelor's Degree Recipients

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A five-percent increase over last year brought the total number of physics bachelor's degrees granted in 1982–83 to the largest total in ten years. Astronomy bachelors, on the other hand, comprised the smallest total since we began collecting these data in the mid 1970's. The survey upon which this report is based directly queries individual degree recipients; its purpose is to determine their postbaccalaureate plans and to examine any changes exhibited by the class of 1983. Highlights of the information presented in this report are:

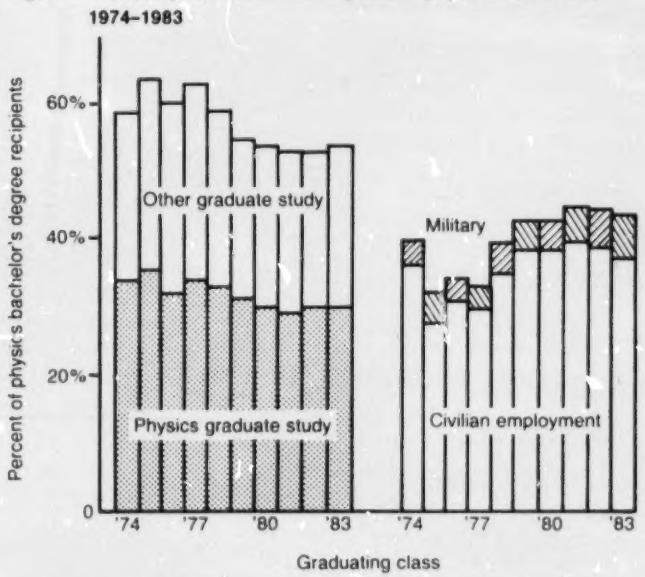
—a gradual increase in the ages at which physics students complete their bachelor's degrees.

—a further increase in the proportion of physics bachelors who did not take physics in high school.

—a doubling of the proportion of physics bachelors who entered the military since 1973.

Changes in the postbaccalaureate plans of physics bachelors for the past ten years are shown in **Figure I** and **Table I**. The figure presents two sets of bars, one for graduate study and one for employment, thereby indicating an almost even split between those two major career goals. A further distinction included in **Figure I** is the relative proportion of bachelors who continue to study physics and those who switch to other disciplines of graduate study. Similarly, the employment-oriented graduates are divided into those entering the military and those who seek civilian employment.

Figure I. Trend in postbaccalaureate plans of physics bachelors, 1974–1983



The numerical data for the bars in **Figure I** are presented in **Table I** which clearly indicates the gradual but steady increase in the percentage of physics bachelors who enter the military. During the most recent ten-year period, that percentage doubled. In **Table I**, the bottom row lists the total number of physics bachelor's degrees granted in each year.

Table I. Postbaccalaureate plans of successive graduating classes of physics bachelors, 1973–1983.

Postbaccalaureate plans	1973–74	1974–75	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83
Physics graduate study	34%	36%	32%	34%	33%	31%	30%	29%	30%	30%
Other graduate study	25	27	28	28	26	24	24	24	23	24
Civilian employment	36	28	31	30	34	38	38	39	38	36
Military service	4	4	4	4	5	5	5	6	7	8
Undecided	1	5	5	4	2	2	3	2	2	2
Total number of physics bachelor's degrees	4652	4571	4487	4517	4457	4416	4440	4513	4558	4795

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Table II. Characteristics of new physics bachelors, 1982–83.

Characteristics	Postbaccalaureate plans: Graduate study: physics	other	Employment	Undecided	Total
Sex					
Female*	11%	14%	10%	18%	11.3%
Male	89	86	90	82	88.7
Citizenship					
U.S.	89%	92%	98%	98%	93.8%
Foreign	11	8	2	2	6.2
Age					
20 or younger	1%	1%	–	–	0.8%
21	8	7	2%	2%	5.1
22	47	51	39	45	43.5
23	21	25	24	28	23.1
24–27	17	12	23	17	19.1
28 and older	6	4	12	8	8.4
Minority groups					
U.S. blacks	0.5%	1.8%	2.3%	–	1.6%
Other U.S. minorities	3.1	5.7	3.8	4.0%	4.1
Foreign minorities	7.6	6.7	1.5	2.0	4.7
Double major					
Yes	25%	39%	27%	38%	29.4%
No	75	61	73	62	70.6
Type of undergraduate institution					
PhD-granting	53%	46%	38%	29%	45.7%
MS-granting	15	8	15	12	11.6
BS/BA-granting	32	46	47	59	42.7
Total number of bachelors	1448	1136	2115	96	4795
% distribution	30%	24%	44%	2%	100%
Number of respondents	762	596	1112	50	2520

**Percentage of women was adjusted for differential response rate.*

When analyzing major characteristics of a class of physics bachelors, they become more meaningful when examined separately for each subgroup according to its postbaccalaureate plan. Thus **Table II** presents six major characteristics on that basis. For example, looking at the age distributions of graduates, we find that employment-oriented bachelors tend to be older than those headed for graduate study. Furthermore, the median age of the group interested in "other graduate study" is even slightly lower than that of the group headed for graduate study in physics.

Almost 30% of the physics bachelors graduate with a double major each year. But examining the components of the composite group, we find that a much higher proportion of the graduates who switched to another discipline had double majors than the groups who entered employment or graduate study in physics.

Changes in characteristics from the previous year include a small increase in foreign minorities among the physics bachelors, as well as an increase in those who graduated from the four-year colleges.

Figure II. Physics bachelors, entering graduate physics departments, who did not take high school physics, 1973–1983.

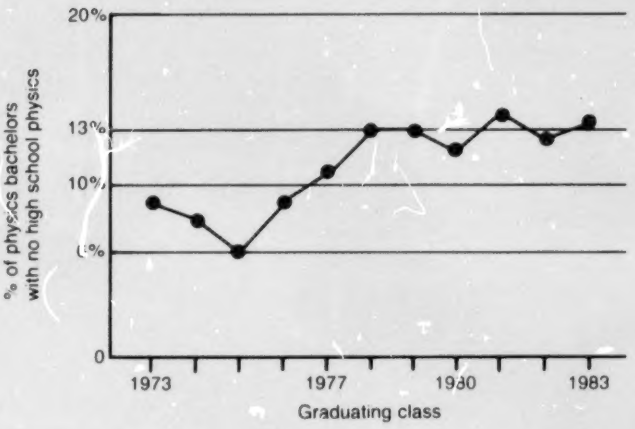


Table III. A comparison between men and women 1982–83 physics bachelors having taken high school physics.

Type of high school physics		Women	Men	Total %	N
PSSC*		21%	27%	26%	558
Project physics		12	14	14	288
Other		43	43	43	906
None		24	16	17	359
Total	%	100%	100%	100%	
Respondents	N**	287	1824		2111

PSSC = Physical Science Study Committee
***Nonrespondents to the question = 409*

The attention given to the crisis in high school physics teaching prompted us to examine the high school physics backgrounds of those who graduated with physics bachelor's degrees. Since it is amply documented by studies that physicists develop an interest in their discipline at an early age, one can expect graduating physics majors to have taken physics in high school unless a teacher shortage removed that subject from the curriculum. Both **Figure II** and **Table III** examine the 1983 graduates. The latter finds that 17% of all physics bachelors did not take any physics before entering college; in fact this percentage represents a gradual increase from 13% in 1978. **Figure II** examines subgroups of the graduating classes, namely those bachelors whose post-degree plans were graduate study in physics, and finds that the backgrounds of these potential physicists reflect a similar situation.

Table IV. Postbaccalaureate plans of U.S. and foreign minorities among the physics bachelors of the class of 1983.

Minorities	Postbaccalaureate plans: Graduate study: Physics	Other	Empl.	Total %	N
U.S. blacks	10%	28%	62%	100	40
U.S. Orientals	30	31	39	100	51
Other U.S. minorities	17	35	48	100	52
Total U.S. minorities	20%	31%	49%	100%	143
Foreign Orientals	58%	30%	12%	100	43
Other foreign minorities	45	37	18	100	74
Total foreign minorities	50%	34%	16%	100%	117
All respondents	30%	24%	46%	100%	2520

As mentioned in connection with **Table II**, a composite picture does not always reflect the characteristics of its component parts accurately. A further illustration of that observation is presented in **Table IV** where minority groups are divided on the basis of citizenship and their post-baccalaureate plans compared with those of all respondents of the class of 1983. Thus we find that U.S. minorities favor "other graduate study" over physics and, with the exception of U.S. Orientals, they are more likely to choose employment than any other group in **Table IV**.

Like most foreign students who are in the U.S. on student visas, foreign minorities have few opportunities to choose employment; consequently graduate study is the choice expressed by over 80% of them. A closer examination of that group reveals that a higher proportion of Orientals (58%) than other minorities (45%) report their intention to continue in physics rather than to switch to another discipline for graduate study.

Additional details on minorities are provided in **Table V**. Here 255 responding physics bachelors identify themselves as members of seven distinct minority groups. The larger groups that are neither predominantly foreign nor predominantly U.S. were divided on the basis of citizenship, and the following three characteristics are presented: sex, region, and type of bachelor's institution. Thus the table indicates that foreign Orientals include the highest proportion of women, that U.S. blacks are concentrated in the four-year colleges that are in the southeastern and central regions of the U.S., and that a majority of Orientals (55%) were undergraduates at PhD–granting institutions.

Table V. Selected characteristics of minority physics bachelors, 1983

		Minority group: Black U.S.	Black Foreign	Mex. Amer.	Amer. Ind.	Hispanic U.S.	Hispanic Foreign	Oriental U.S.	Oriental Foreign	Asian Indian	Arab
	Total	40	15	16	1	21	13	51	43	20	35
Sex	Female	6	1	4	1	4	2	8	14	3	3
	Male	34	14	12	–	17	11	43	29	17	32
*Region of bach's inst.	Northeast	6	8	2	–	8	6	19	8	4	10
	Southeast	19	3	–	–	6	3	3	5	7	5
	Central & Mountain	14	4	6	–	1	3	8	19	7	14
	Pacific	1	–	8	1	6	1	21	11	2	6
Type of bach's inst.	PhD-granting	7	3	8	–	9	6	32	20	8	14
	MS-granting	9	2	4	–	7	2	–	9	2	5
	BS/BA-granting	24	10	4	1	5	5	19	14	10	16

**Regions: Northeast = New England, Middle Atlantic; Southeast = South Atlantic, East South Central, Central = East North Central, West North Central, West South Central.*

Table VI. Sources of anticipated support for first-year graduate study*, 1979–83.

Sources of support	Students planning: Physics graduate study 1979	1981	1983	Other graduate study 1979	1981	1983
Teaching assistantship	66%	67%	72%	24%	28	28
Research assistantship	15	14	12	24	18	17
Fellowship	12	10	9	15	13	14
Employment (part-time)	2	4	3	11	15	16
Family, savings, loan	3	4	2	20	21	24
Other	2	1	2	6	5	1
	100%	100%	100%	100%	100%	100%
Graduate study status: full-time	**	92%	91%	**	84%	86%
Graduate study status: part-time	**	8	9	**	16	14
Total number of full-time students	1372	1327	1448	1083	1079	1136

*The information was reported for September of each academic year.
**Data not available.

The sources of support available to physics bachelors who are interested in immediate full-time graduate study, depend very much on the discipline to be studied. If it is physics, **Table VI** shows that the prospective graduate student is almost assured of an assistantship or fellowship. However, if another discipline is selected, securing support is less likely, a conclusion drawn from the fact that 40% of that group reported the use of personal funds in 1983.

The lower portion of **Table VI** includes physics bachelors who have accepted full-time employment and pursue graduate study on a part-time basis. In physics these part-time students comprise less than 10%, whereas those who enter "other graduate study" include 14% to 16% part-time students.

Since almost half of the physics bachelors each year are interested in immediate employment, demand for them is the type of information eagerly sought. Its evaluation is complex, but asking employment-oriented graduates for the number of job offers each received appears to serve as a reasonable indication of demand. **Table VII** presents a trend that points to a job market in which 90% of the graduates find positions in a short time; however, looking at the most recent five-year period, an increasing proportion of bachelors settle for the first position offered, leaving a declining number of graduates who report multiple offers to choose from.

Although post-baccalaureate plans have been discussed in connection with the earlier figures and tables, the flow diagram of **Figure III** offers unique details. In particular, it lists the major subjects of graduate study for those physics bachelors who chose a physics-related or other discipline for their graduate work. And looking at the 1983 distribution, we note that engineering continues to be the most frequently chosen discipline, followed by medicine and the earth/atmospheric sciences. When comparing these numbers with those of the previous year, we give particular attention to disciplines unrelated to physics. On that basis the numbers of potential business and law students appear to decline.

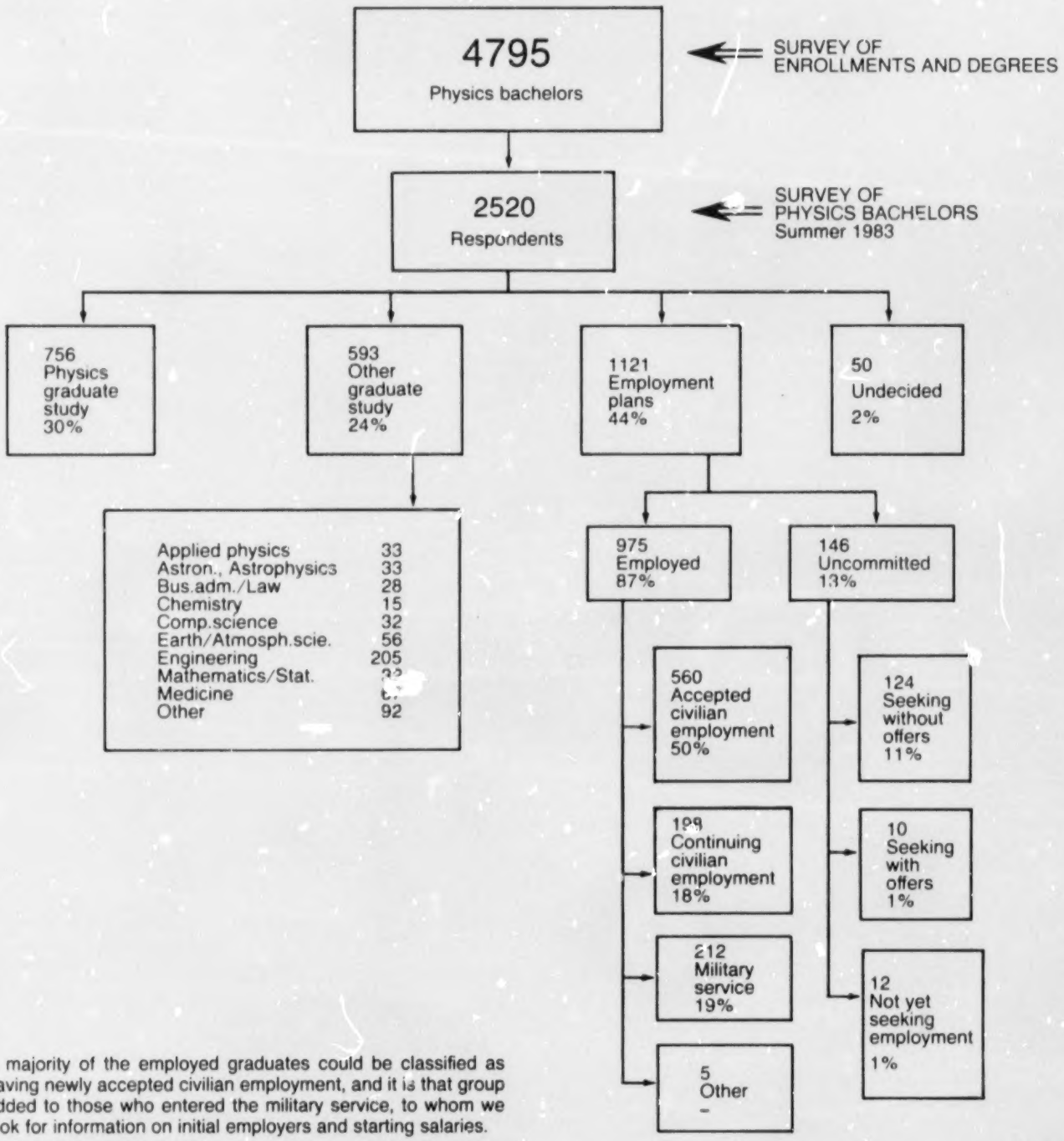
The largest portion of the flow diagram is devoted to details of employment plans. The 1121 respondents are divided into seven categories, four of which reported various types of employment and the remaining three categories could all be described as "uncommitted" by the end of the summer of 1983. As a result of interpreting the responses carefully we were able to distinguish between uncommitted graduates who had put off the task of seeking employment to a later date, and those who were actively seeking employment but had not yet been successful in securing a position. The latter group showed a two percentage-point decline from the previous year when it was 13%.

Table VII. Changes in employment outlook for new physics bachelors, 1973–1983.

Number of job offers at graduation	Summer 1973	Summer 1975*	Summer 1977	Summer 1979	Summer 1980	Summer 1981	Summer 1982	Summer 1983
0	26%	17%	11%	9%	10%	10%	13%	11%
1**	50	56	52	46	50	55	57	38
2 or more	24	27	37	45	40	35	30	31

*These figures have been revised from those presented in earlier reports to include military commitments.
**Bachelors who enter the military service are included here.

Figure III. Postbaccalaureate plans of physics bachelors of the class of 1983



A majority of the employed graduates could be classified as having newly accepted civilian employment, and it is that group added to those who entered the military service, to whom we look for information on initial employers and starting salaries.

Physics bachelors who retain employment they have held while completing their undergraduate studies, or perhaps summer jobs, are described as "continuing civilian employment" in the flow diagram of **Figure III**. A small contingent of these 198 graduates actually described themselves as "employed, but seeking" as they look for more appropriate positions.

Table VIII. Initial employment of physics bachelors, 1975–83.

Type of employer	Percentage of employed bachelors							
	1975–75	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83
Industry { manufacture	30%	32%	37%	40%	41%	40%	38%	33%
Industry { service	19	16	21	18	20	22	22	20
High school	11	8	7	6	3	2	3	4
College or univ.	4	5	3	4	3	4	4	4
Government { civilian	10	7	7	7	8	7	7	10
Government { military	13	12	14	15	16	21	24	27
Other	13	20	11	10	9	4	2	2
Total	100%	100%	100%	100%	100%	100%	100%	100%

Table IX. Starting salaries of physics bachelors, 1983.

Type of employer	Men (504 reported salaries) Dist. by employer	Median monthly salary	Women (81 reported salaries) Dist. by employer	Median monthly salary	Total (585 reported salaries) Dist. by employer	Median monthly salary
Industry-manufacture	32%	$2 100	35%	$2 060	33%	$2 090
Industry-service	19	1 785	27	1 975	20	1 820
High school	4	1 100	6	1 150	4	1 130
Coll/Univ.	4	1 350	2	**	4	1 350
Government Civilian	8	1 480	12	1 390	8	1 450
Government Military	29	1 425	13	1 550	27	1 435
FFRC	2	1 825	2	**	2	1 750
Other	2	1 080	3	**	2	1 090
Total	100%	$1 635	100%	$1 850	100%	$1 670

***Insufficient data*

The class of 1983 included reports from 772 bachelors who accepted new positions from civilian and military employers. **Table VIII** presents the types of employers and compares them with the initial employment reported by earlier graduating classes of physics bachelors. Two significant changes in the proportions in which types of employers engage new physics bachelors are noteworthy: (a) Offers from industry reflect a substantial decrease, and (b) the military continues to attract an increasing proportion of graduates. An explanation for the growing attraction represented by the military, is probably the additional training it funds, as well as the job security it offers to college graduates. Also the civilian government hired a larger proportion of bachelors in 1983.

Another consequence of choosing military service is its impact on salary. **Table IX** substantiates this statement by listing the median monthly starting salaries for major employers of physics bachelors. As long as the military attracts an increasing proportion of physics bachelors, it causes the total median salary to decline. The $1670.— per month reported by the 1983 graduates represents a 2.3% decrease from the previous year. But since a much larger number as well as a higher proportion of men than women join the military, the $1635.— for men represents a 2.7% decrease from 1982, whereas the median salary for women remained essentially stable.

Without attaching too much importance to a small change, it should be mentioned that salaries for newly employed high school teachers rose almost 8%, as the percentage of physics bachelors so employed increased from 3% in 1982 to 4% in 1983.

To summarize the data in **Table IX**, changes in starting salaries for all types of employers can be described as minimal between 1982 and 1983.

To complete the employment picture presented in **Tables VII** through **IX** it is necessary to include the data from the 198 bachelors (see **Figure III**) who had started their work before graduation. Consequently **Table X** shows the types of employers and corresponding work activities of newly accepted as well as continuing employment. A comparison of the employer distribution between **Tables VIII** and **X** indicates that graduates who continued their employment worked primarily in industry. The distribution of work activities is almost identical to that of the previous year.

Table X. Full-time employment* of new physics bachelors, 1983.

Work activity	Industry: manufacture	Industry: service	High school	Government: civilian	Government: military	Coll/univ.	Other	Total: N	Total: %
Teaching	–	4	32	10	–	5	6	57	6
Res. & dev.	45	21	–	31	27	16	4	144	15
Dev. & design	108	23	–	16	9	–	1	157	16
Programming	87	85	–	43	12	10	4	241	25
Skilled work	57	40	–	8	8	7	6	126	13
Pilot/navigator training	1	–	–	–	51	–	–	52	5
Nuclear power school	–	–	–	–	47	2	–	49	5
Other prof. work	13	18	–	3	20	–	5	59	6
Other	8	24	–	4	38	3	8	85	9
Total N	319	215	32	115	212	43	34	970	
Total %	33%	22%	3%	12%	22%	4%	4%		100%

**The employment of these 970 graduates includes both newly accepted positions as well as those in which graduates are continuing.*

ASTRONOMY

Table XI. Postbaccalaureate plans of successive graduating classes of astronomy bachelors, 1975–83.

Postbaccalaureate plans	1975–76	1976–77	1977–78	1978–79	1979–80	1980–81	1981–82	1982–83
Astronomy graduate study	46%	28%	33%	28%	35%	24%	29%	38%
Other graduate study	29	27	22	19	17	13	25	17
Employment	20	33	40	51	43	59	45	41
Undecided	5	12	5	2	5	4	1	4
Total number of astronomy bachelors	172	184	177	165	165	156	181	138

The graduating class of 1983 astronomy bachelors is unusually small which, in turn, may account for the widely fluctuating postbaccalaureate plans between the classes of 1982 and 1983. **Table XI** traces those plans of successive graduating classes back to the mid 1970's and, despite fluctuations, reveals an early shift toward employment, followed by a more recent shift toward graduate studies.

The format of **Table XII** is similar to that of **Table II** because both tables relate major characteristics of bachelor's degree recipients to their postbaccalaureate plans. The response rate of astronomy bachelors is the same (53%) as that of the physics bachelors, but **Table XII** presents numbers, instead of percentages, for the individual groups because of the small number of respondents.

General observations show that an undergraduate astronomy curriculum attracts a higher proportion of women, fewer foreign students and almost no minorities, as compared with physics.

Table XII. Characteristics of astronomy bachelors, 1983.

Characteristics		Postbaccalaureate plans: Graduate study, Astronomy N	Graduate study, Other N	Employment N	Undecided N	Total %
Sex	Female	7	4	10	2	32%
	Male	21	8	20	1	68
Citizenship	U.S.	28	12	30	3	100%
	Foreign	–	–	–	–	–
Type of high school physics	PSSC	5	2	5	–	17%
	Project physics	3	–	3	1	10
	Other	17	8	18	1	63
	None	2	1	3	1	10
Age	21 or younger	–	1	3	–	5%
	22 yrs.	18	7	10	1	50
	23 yrs.	4	2	10	–	22
	24 or older	6	2	7	2	23
Type of bachelor's institution	PhD-granting	23	6	21	1	70%
	MS-granting	2	–	–	–	3
	BS/BA-granting	3	6	9	2	27
Type of degree	Science	17	3	22	1	59%
	Arts	11	9	8	2	41
Double major	with physics	11	8	6	1	36%
	with mathematics	1	–	4	–	7
	with other	–	1	2	1	5
Total respondents		28	12	30	3	73

Fig. IV. Postbaccalaureate plans of astronomy bachelors of the class of 1983

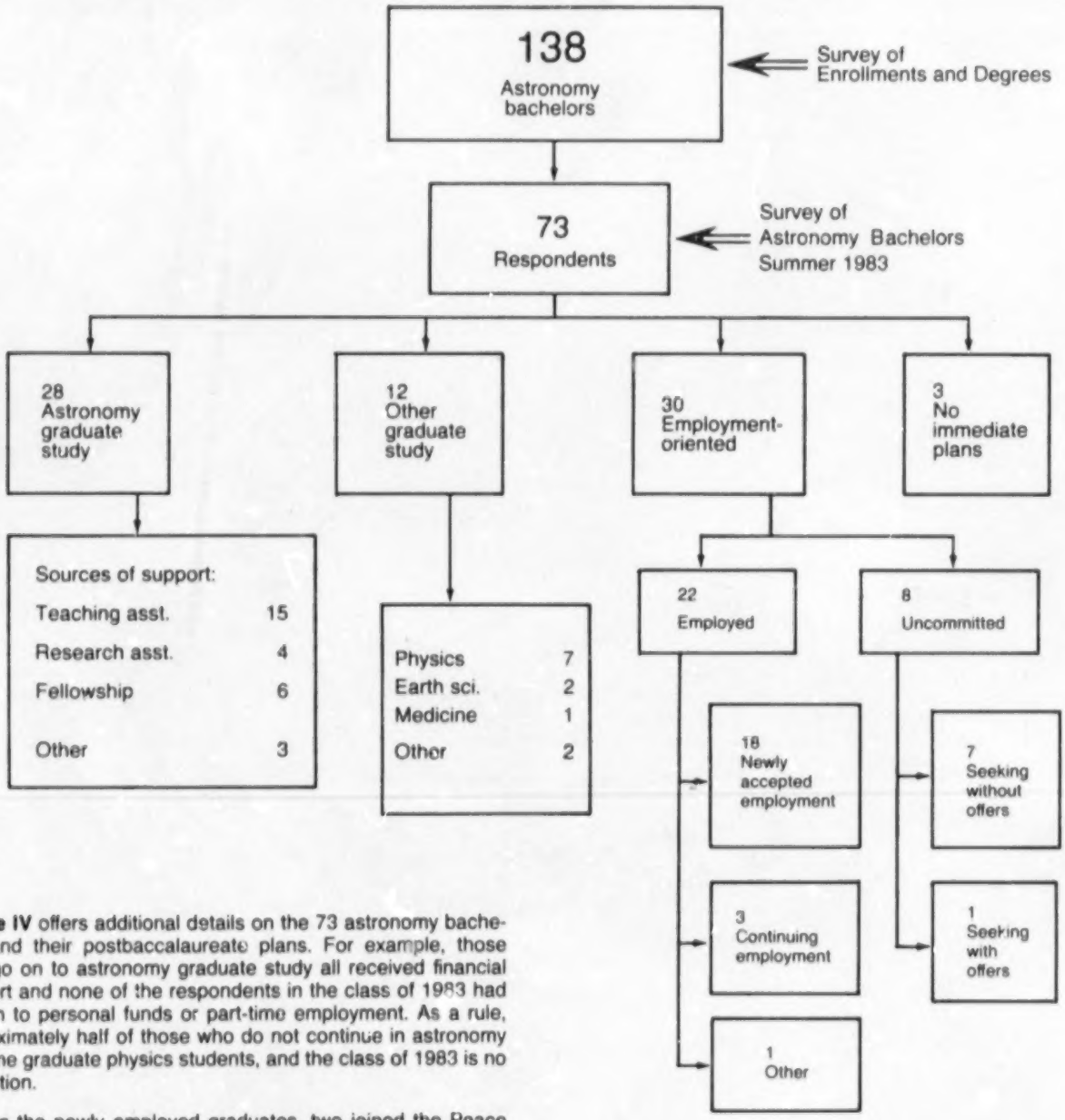


Figure IV offers additional details on the 73 astronomy bachelors and their postbaccalaureate plans. For example, those who go on to astronomy graduate study all received financial support and none of the respondents in the class of 1983 had to turn to personal funds or part-time employment. As a rule, approximately half of those who do not continue in astronomy become graduate physics students, and the class of 1983 is no exception.

Among the newly employed graduates, two joined the Peace Corps and two became high school astronomy teachers. Each of the teachers had three job offers.